

CLAIMS

What is claimed is:

1 1. A method of illuminating a display screen of a flat panel display so
2 as to smoothly and dynamically vary a display screen illumination level between a
3 predetermined maximum illumination level suitable for viewing of the display screen in
4 ambient daylight conditions and a predetermined minimum illumination level suitable for
5 viewing of the display screen in ambient night conditions, comprising the steps of:

6 monitoring a level of ambient light incident on the display screen to
7 determine a desired display screen illumination level within a range defined between the
8 predetermined maximum and minimum illumination levels;

9 monitoring the current display screen illumination level and providing said
10 monitored level to a display screen illumination level controller that is operable for
11 illuminating the display screen at said determined desired display screen illumination
12 level by:

13 varying a one-hundred-percent duty cycle fluorescent electrical
14 control signal for operating a fluorescent lamp disposed for illuminating the
15 display screen between a first fluorescent control signal level for illuminating the
16 display screen at the predetermined maximum illumination level and a second
17 fluorescent control signal level for illuminating the display screen at a
18 predetermined transition illumination level less than the predetermined maximum
19 illumination level but greater than the predetermined minimum illumination level
20 and greater than a minimum fluorescent operating control signal level sufficient

for maintaining continuous constant-brightness output from the fluorescent lamp at a one-hundred-percent duty cycle, so as to illuminate the display screen at the determined desired display screen illumination level when the determined desired display screen illumination level is between said predetermined maximum illumination level and said predetermined transition illumination level;

varying an LED electrical control signal for operating at least one light emitting diode disposed for illuminating the display screen between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen at the desired display screen illumination level when the determined desired display screen illumination level is between said predetermined transition illumination level and said predetermined minimum illumination level;

as the desired display screen illumination level decreases to said predetermined transition illumination level, discontinuing supply of the fluorescent control signal to the fluorescent lamp to discontinue illumination output from the fluorescent lamp, supplying the LED control signal to the at least one light emitting diode, and varying the LED control signal in accordance with the monitored current display screen illumination level to illuminate the display screen at the determined desired display screen illumination level; and

42 as the desired display screen illumination level increases to said
43 predetermined transition illumination level, initiating supply of the fluorescent
44 control signal to the fluorescent lamp to initiate illumination output from the
45 fluorescent lamp, varying the LED control signal in accordance with the
46 monitored current display screen illumination level to assist the fluorescent tube
47 in illuminating the display screen at the determined desired display screen
48 illumination level as the fluorescent tube is initially powered, and discontinuing
49 supply of the LED control signal to the at least one light emitting diode when the
50 monitored current display screen illumination level indicates that the illumination
51 output of the fluorescent tube is sufficient to illuminate the display screen to the
52 determined desired display screen illumination level.

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1 2. Apparatus for illuminating a display screen of a flat panel
2 display so as to smoothly and dynamically vary a display screen illumination level
3 between a predetermined maximum illumination level suitable for viewing of the
4 display screen in ambient daylight conditions and a predetermined minimum
5 illumination level suitable for viewing of the display screen in ambient night
6 conditions, said apparatus comprising:

7 an ambient light sensor for monitoring a level of ambient light incident on
8 the display screen to determine a desired display screen illumination level within a
9 range defined between the predetermined maximum and minimum illumination levels;

a display illumination level sensor for monitoring the current display screen illumination level;

a fluorescent lamp disposed for illuminating the display screen;
at least one light emitting diode disposed for illuminating the display screen;

a display screen illumination level controller connected to the ambient light sensor for determining from the monitored level of incident ambient light a desired display screen illumination level within a range defined between the predetermined maximum and minimum illumination levels, and to the display illumination level sensor for receiving the monitored current display screen illumination level, and connected to the fluorescent tube and to the at least one light emitting diode, said controller being operable for illuminating the display screen at the determined desired display screen illumination level by:

varying a one-hundred-percent duty cycle fluorescent electrical control signal for operating the fluorescent lamp between a first fluorescent control signal level for illuminating the display screen at the predetermined maximum illumination level and a second fluorescent control signal level for illuminating the display screen at a predetermined transition illumination level less than the predetermined maximum illumination level but greater than the predetermined minimum illumination level and greater than a minimum fluorescent operating control signal level sufficient for maintaining continuous constant-brightness output from the fluorescent lamp at a one-hundred-percent

duty cycle, so as to illuminate the display screen at the determined desired display screen illumination level when the determined desired display screen illumination level is between said predetermined maximum illumination level and said predetermined transition illumination level;

varying an LED electrical control signal for operating the at least one light emitting diode between a first LED control signal level for illuminating the display screen at the predetermined transition illumination level and a second LED control signal level for illuminating the display screen at the predetermined minimum illumination level, so as to illuminate the display screen at the desired display screen illumination level when the determined desired display screen illumination level is between said predetermined transition illumination level and said predetermined minimum illumination level;

as the desired display screen illumination level decreases to said predetermined transition illumination level, discontinuing supply of the fluorescent control signal to the fluorescent lamp to discontinue illumination output from the fluorescent lamp, supplying the LED control signal to the at least one light emitting diode, and varying the LED control signal in accordance with the monitored current display screen illumination level to illuminate the display screen at the determined desired display screen illumination level; and

as the desired display screen illumination level increases to said predetermined transition illumination level, initiating supply of the fluorescent control signal to the fluorescent lamp to initiate illumination output from the

54 fluorescent lamp, varying the LED control signal in accordance with the
55 monitored current display screen illumination level to assist the fluorescent tube
56 in illuminating the display screen at the determined desired display screen
57 illumination level as the fluorescent tube is initially powered, and discontinuing
58 supply of the LED control signal to the at least one light emitting diode when the
59 monitored current display screen illumination level indicates that the illumination
60 output of the fluorescent tube is sufficient to illuminate the display screen to the
61 determined desired display screen illumination level.